

REMARKS

The Examiner's Office Action of July 28, 2004 has been received and its contents reviewed. Applicants would like to thank the Examiner for the consideration given to the above-identified application. No amendments having been made, claims 1-10 are pending for consideration, of which claims 1, 2 and 6 are independent. In view of the following remarks, reconsideration of this application is now requested.

On page 2 of the Office Action, claim 1 stands rejected under 35 U.S.C. §103(a) as being unpatentable over U.S. Patent No. 6,211,065 to Xi et al. (hereinafter Xi) and claims 2-5 are rejected under 35 U.S.C. §103(a) as being unpatentable over U.S. Patent No. 6,057,239 to Wang et al. (hereinafter Wang) in view of Xi and U.S. Patent No. 6,057,247 to Imai et al. (hereinafter Imai). Applicants respectfully traverse these rejections.

The Xi patent is directed to a method of depositing an amorphous fluorocarbon film using a high bias power applied to the substrate on which the material is deposited (see Abstract). The Wang patent is directed to a dual damascene process for forming a contact hole for an integrated circuit and the Imai patent is directed to a method for fabricating a semiconductor device inside a chamber and for controlling the environment within the chamber (see Abstract).

The present invention, on the other hand, is directed to a method for fabricating a semiconductor device. The method comprises depositing a fluorine-containing organic film having a relative dielectric constant of 4 or less on a semiconductor substrate using a material gas containing C_4F_6 as a main component. By selecting a material gas containing C_4F_6 as a gas or film for deposition, the amount of fluorine atoms within the fluorine-containing organic film is increased and thus a fluorine-containing organic film having a small relative dielectric constant can be achieved as compared to films deposited using gases such as C_2F_6 and C_4F_8 . Further, the amount of free fluorine atoms contained in the film deposited by the present invention is less than that in fluorine-containing organic films deposited by using conventional gases such as CF_4 , C_2F_6 , C_2F_8 and C_4F_8 . Thus a fluorine-containing organic film having better adhesion to the underlying film can be obtained.

Turning to the rejections, the Office Action admits that the Xi patent fails to disclose a material gas containing C_4F_6 as a main component. However, the Office Action points out that in column 10, lines 58-64, Xi discloses that other fluorine sources can be employed as

long as the atomic ratio of F:C available in the chamber is less than 2. The passage used for motivation for obviousness has nothing to do with suggesting C₄F₆ as a main component. The entire passage reads as follows:

In one embodiment performed on a 200 mm substrate, the preferred precursor gases are octafluorocyclobutane (C₄F₈) and methane (CH₄) which are flown into the chamber at a selected rate to maintain the atomic ratio of less than 2 (two), preferably in a range between about 20 sccm and about 200 sccm. Argon, or other inert gas, is flown into the chamber at a rate of from about 20 sccm to about 100 sccm to sputter the growing surface in situ as deposition is performed on the substrate. A bias power greater than 100 W, preferably about 1000 W, is applied to the substrate support member to achieve a preferred C-F bonding structure in the film at an acceptable deposition rate. A bias power of about 1000 W provided the desired gap fill performance at 0.25 .mu.m widths. Other carbon gas surfaces such as CH₄, C₂H₄, C₂H₆, C₂H₂, C₆H₆, CF₄, C₂F₆, C₃F₈, CHF₃, and C₆F₆ and **fluorine gas sources such as CF₄, C₂F₆, C₃F₈, CHF₃, and C₆F₆ may be used so long as the atomic ratios of F:C available in the chamber remain less than 2.** Additionally, other inert bombarding gases known in the field can be used. (emphasis added)

Applicants submit that there is no suggestion to employ C₄F₆ as a main component within this passage. Applicants submit that Xi completely fails to disclose or suggest substituting C₄F₆ as a main component as opposed to the perfluorinated gas that Xi teaches. It appears that the Examiner assumes that simply using C₄F₆ yields a F:C ratio that is less than 2. However, as indicated in column 10, lines 40-42 of Xi, a carbon source is flown into a chamber to decrease the atomic ratio of F:C in the precursor gases to less than 2. In other words, the Xi patent indicates that the atomic ratio is dependent upon the amount of F and C in the chamber and not merely upon the molarities of the gas. Accordingly, Applicants note that there is no motivation, absent impermissible hindsight, to employ C₄F₆.

To imbue one of ordinary skill in the art with knowledge of the invention, when no prior references of record convey or suggest that knowledge, is to fall victim to the insidious effect of hindsight syndrome wherein that which only the inventor taught is used against its teacher. W.L. Gore & Assoc. v. Garlock, Inc., 721 F.2d 1540, 1533, 220 USPQ 303, 312-13 (Fed. Cir. 1983). Furthermore, “[w]here the prior art provides “only general guidance and is not specific as to the particular form of the invention or how to achieve it, [such a suggestion] may make an approach ‘obvious to try,’ but it does not make the invention obvious.” Ex

parte Obukowicz, 27 USPQ2d, 1063, 1065 (U.S. Patent and Trademark Office Board of Appeals and Interferences, 1992) and In re O'Farrell, 7 USPQ2d 1673, 1681 (Fed. Cir. 1988).

As such, Applicants submit that merely because Xi reduces the atomic ratio of various gases, which do not include C₄F₆, does not mean that one of ordinary skill would look to employ C₄F₆ as a main component when there is no suggestion to do so. Accordingly, Applicants respectfully request reconsideration and withdrawal of the objection.

With regard to claims 2-4 rejected in view of Wang, Xi and Imai, Applicants respectfully traverse this rejection for at least the same reasons as described above with regard to independent claim 1. As acknowledged in the Office Action, neither Wang nor Imai solve the deficiencies of Xi by disclosing C₄F₆ as a main component as required by independent claim 2. Moreover, as discussed above there is no motivation to employ this compound other than improper hindsight reconstruction of the present invention. Accordingly, Applicants respectfully request reconsideration and withdrawal of the rejection.

On page 4 of the Office Action, claim 6 stands rejected under 35 U.S.C. §103(a) as being unpatentable over U.S. Patent No. 6,104,092 to Matsubara et al. (hereinafter Matsubara); claims 7, 8 and 10 are rejected under 35 U.S.C. §103(a) as being unpatentable over Matsubara in view of U.S. Patent No. 5,277,750 to Frank; and claim 9 is rejected under 35 U.S.C. §103(a) as being unpatentable over Matsubara in view of Frank further in view of U.S. Patent No. 6,136,211 to Qian et al. (hereinafter Qian). Applicants respectfully traverse these rejections.

Matsubara is directed to a semiconductor device and an associated method of manufacture where the device has an insulation material that is an amorphous carbon fluoride film. Frank is directed to a method for anisotropic dry etching of metallization layers containing aluminum or aluminum alloys and Qian is directed to a self cleaning etch process.

On the other hand, the present invention as provided in independent claim 6 is directed to a method for fabricating a semiconductor device. A metal film is deposited on a semiconductor substrate and a mask pattern made of a resist film or an insulating film is formed on the metal film. The metal film is dry etched using the mask pattern to form a plurality of metal interconnections made of the metal film and a fluorine-containing organic film having a relative dielectric constant of 4 or less is deposited as an interlayer insulating film between the plurality of metal interconnections and on top surfaces of the metal

interconnections using a material gas containing C_4F_6 as a main component. Applicants respectfully submit that none of Matsubara, Frank or Qian teach or suggest each and every feature of the invention.

For example, Matsubara as acknowledged in the Office Action (and like Xi above) does not disclose or suggest C_4F_6 as a main component. To solve this deficiency, the Examiner merely indicates that “it would have been obvious at the time of the invention for one skill[ed] in the art to use other fluorine gas such as C_5F_8 or C_4F_6 in order to deposit the organic film with an anticipation of an expected result. Applicants respectfully submit that such reasoning is wholly insufficient to provide a *prima facie* case of obviousness. Applicants note that the MPEP (§§ 2142-2143) indicates that “to establish a *prima facie* case of obviousness, (1) there must be some suggestion or motivation (either in the references themselves or in the knowledge generally available to one of ordinary skill in the art) to combine the reference teachings; (2) there must be a reasonable expectation of success; and (3) the prior art references when combined must teach or suggest all claim limitations.” (emphasis added). Applicants submit that there is no such suggestion or motivation provided here and request that if this rejection is maintained that such motivation be provided to enable a more detailed response by Applicants.

Moreover, Applicants respectfully submit that claims 7-10 are allowable for at least the same reasons provided above with regard to independent claim 6, as well as for reasons of their own.

Thus, in view of the amendments and arguments set forth above, Applicants respectfully request reconsideration and withdrawal of all the pending rejections.

While the present application is now believed to be in condition for allowance, should the Examiner find some issue to remain unresolved, or should any new issues arise, which could be eliminated through discussions with Applicants' representative, then the Examiner is invited to contact the undersigned by telephone in order that the further prosecution of this application can thereby be expedited.

Respectfully submitted,



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